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(19)

(54) IMPROVEMENTS RELATING TO VEHICLE WINDOW WIPING ARRANGEMENTS

(71) I, PETER HENRY CASSWELL a British subject of 10 Brookdale Road, Bramhall, Cheshire, England, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:

This invention relates to control apparatus for an arrangement for wiping rain from vehicle windows.

Wiper control apparatus has been proposed including a detection pad carrying spaced apart conductors and actuated by moisture forming a conducting path between the conductors. A heater carried by the pad serves to evaporate any such moisture at a predetermined rate so that only precipitation in excess of a desired level causes actuation.

Such a control arrangement when used solely for wiping is inelegant in that it requires the detector pad to be mounted outside the vehicle with attendant installation problems and it is vulnerable to contamination by the atmosphere.

It is an object of the present invention to provide control apparatus for an arrangement for wiping rain from vehicle windows which mitigates the above disadvantages.

According to the present invention control apparatus for a vehicle window wiper arrangement comprises a source of electromagnetic radiation arranged to be mounted in the vehicle adjacent the window to be wiped to direct a beam of radiation at the window, a receiver of the electromagnetic radiation located so as to receive the radiation by way only of the window and circuit means responsive to a predetermined rate of increase in mean intensity of said received radiation caused by refraction or reflection of the radiation by precipitation approaching or contacting the window to provide a signal to cause the window wiper arrangement to be energised.

The beam may be transmitted as a series of pulses. The radiation may be in the infra-red part of the spectrum. The receiver may be provided with a filter transparent to radiation at the transmitted frequency.

In one embodiment the circuit means includes a comparator arrangement to be fed signals from the receiver and responsive to a change in input signal level to compare the rate of change with a threshold value to provide a control signal indicative of a change, from an ambient level, having predetermined characteristics.

The circuit means may include timing means operable to cause operation of the wiper from a predetermined period of time after energisation of the wiper.

The circuit means may include means responsive to detection of the wiper sweeping the window subsequent to energisation of the wiper by detection of precipitation to inhibit operation due to detection only of the wiper blade.

The control arrangement may include further timing means responsive to a predetermined interval between wiper energisations to energise window washing means simultaneously with the next wiper energisation.

The control arrangement may also include clamping means responsive to the reception of extraneous radiation to inhibit operation unless the rate of change of intensity is within predetermined limits.

An embodiment of the invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows the radiation transmitter and receiver in position in a vehicle to illustrate operation of the arrangement.

Figure 2 is a schematic block circuit diagram of a complete vehicle window wiper control arrangement according to the pre-

sent invention.

Figure 3(a) shows in greater detail the circuit arrangement of the comparator and *Figure 3(b)* shows the circuit arrangement of the strong extraneous light clamp.

Referring to Figure 1 a window wiper control arrangement comprises a transmitting/receiving station 10 located against the inside face of a glass windscreen 11 of a vehicle. The station comprises a transmitter of infra-red radiation in the form of a semiconductor diode 12 arranged to direct a beam of the infra-red radiation at the screen in a substantially horizontal plane and at about 70° to the normal of the screen; a receiver in the form of a phototransistor 13 having a peak response corresponding to the frequency of the transmitted beam, a filter 14 to reduce the amount of radiation at other frequencies reaching the detector, and a lens 15 to concentrate radiation from a region in front of the screen on to the detector; and an opaque barrier 16 to prevent radiation reaching the detector except by way of the glass of the screen.

In operation it will be appreciated that some of the transmitted radiation reaches the detector by way of reflection from within the screen and some is received from outside the vehicle by way of the screen. Such received radiation is considered as ambient in that changes in its intensity take place slowly.

When a raindrop 17 approaches the screen and, still substantially in its spherical form in the optical plane of the device, enters the transmitted beam, light is refracted by the drop and redirected towards the receiver causing a sudden increase in the level of received light. The change in light level results in a corresponding increase in receiver signal which is utilised by the circuit arrangement of Figure 2.

The transmitter is shown at 12' driven by a pulse generator 21 at approximately 40 kHz. The receiver phototransistor 13' feeds a signal to a narrow band amplifier 22 in which the received pulse signal is converted to sinusoidal form and then passed to a comparator 23.

The comparator (described in detail hereinafter) produces an output signal when it detects a change in signal level in excess of a predetermined rate. The output of the comparator 23 is connected to a trigger input of a first bistable circuit 24 such signal applied causing it to be set and provide a signal at output 25.

The terminal 25 is connected to a time delay network 26 of about ¼ second delay and by a gate 27 to a trigger input of a second bistable circuit 28. When triggered the second bistable circuit 28 is set to provide an output on line 29 to actuate a wiper relay 30. The gate 27 is also connected to a time delay circuit 31 which when triggered provides a signal to a second gate 32 after a time delay of about ten seconds.

The output of the second gate 32 is connected to a reset input of the second bistable circuit 28 so as to remove the output from line 29. Thus each time the second bistable circuit 28 is triggered the wiper relay is energised for a period corresponding to the ten second delay after which it is de-energised by reset of the second bistable circuit.

The effect of the wiper blade sweeping across the screen through the transmitted beam causes an increase in the level of detected radiation which would trigger the wiper mechanism for a further 10 second period and could result in continuous operation of the wipers. The change in level due to the wiper blade is, however, much larger than that due to a raindrop and this property is employed to prevent false operation.

In parallel with the comparator 23 is a wiper blade detector 33 consisting of a further comparator arranged to compare the amplitude of the receiver signal with a threshold value (in excess of that due to detection of a raindrop) and to provide a signal each time that the wiper sweeps the screen. The output of the wiper detector 33 is connected to a reset input 34 of the first bistable circuit 24 and a signal so applied removes the output from terminal 25 to reset the bistable circuit. The delay 26 ensures that if passage of a wiper is detected by detector 33 and by comparator 23 the output will be removed from terminal 25 of the bistable 24 almost at the instant it is produced and before the gate 27 is triggered.

The comparator 23 is shown in detail in Figure 3(a). The input terminal 41 feeds two identical detector circuits 42 (consisting of diode D1, resistor R1 and capacitor C1) and 43 (D2, R2, C2). The detectors 42 and 43 are connected to an inverting and non-inverting inputs respectively of an amplifier 44. Thus even though the input signal at 41 changes level, such a change is applied equally to each amplifier input. The detector 43 feeds by way of a high pass filter network consisting of resistor R3, potentiometer RV3 capacitor C3 to a transistor switch 45 connected so as to shunt the non-inverting input of the amplifier. Thus when a change in comparator input signal is detected in excess of a rate determined by R3 and C3 and the setting of RV3 the transistor 45 is turned on and the inputs to amplifier 44 made unequal such that the comparator produces an output signal. The potentiometer RV3 provides a convenient means for altering the sensitivity of the comparator. Because ambient light is used to provide a signal for both channels of the

comparator the circuit is in effect insensitive to the amount of light received as ambient, that is, it can be mounted in different locations and in different types of vehicle without requiring initial setting up or subsequent adjustment.

Additional features maybe provided to the basic circuit described. The inputs to wiper relay 30 may also be connected to a third delay circuit 35 producing a time delay of about 5 minutes. The output of the delay circuit is connected to operate a relay 36 of a screen washer such that if a raindrop is detected after an interval between wiper operations of more than 5 minutes the screen is washed as well as wiped.

Although in all the above described embodiments the output signals have been described as actuating relays any other suitable electrically operated switching device may be employed.

A further feature of the circuit is shown in Figure 3(b) and comprises a clamp arrangement 46 operable in conditions of strong extraneous light to prevent erroneous operation of the comparator. Because the detector receives infra red radiation by way of the windscreen, when strong sunlight or the like within the spectral range of the receiver impinges on the screen the phototransistor of the detector may be caused to limit and when the normal light returns could result in a sudden change in gradient which turns on transistor 44.

The clamp circuit is shown in Figure 3(b) and consists of two transistors 47 and 49. Transistor 49 when switched on inhibits the output from comparator 23. Under normal conditions transistors 47 and 49 are in the off condition. The input to transistor 47 is derived from the collector of phototransistor 13. When the extraneous light exceeds a threshold the collector current of 13 will be such as to turn transistor 47 to the on condition. C4 will discharge through 47 and transistor 49 will be switched on. The device is thereby inhibited from operating. When the strong extraneous light is removed transistor 47 is switched off and transistor 49 switched off under control of the time constant of C4 and resistor R4. This delay time is of the order of 2 seconds after which time the comparator circuitry is reactivated.

Also it will be appreciated that while the circuit is primarily intended to respond to approaching drops of rain, it will also respond to other reflective material, such as snow, approaching the window and to material resting on the window if such material prevents light from leaving the window and causes it to be internally reflected to the receiver.

WHAT I CLAIM IS:-

1. Control apparatus for a vehicle window wiper arrangement comprising a source of electromagnetic radiation arranged to be mounted in the vehicle adjacent the window to be wiped to direct a beam of radiation at the window, a receiver of the electromagnetic radiation located so as to receive the radiation by way only of the window and circuit means responsive to a predetermined rate of increase in mean intensity of said received radiation caused by refraction or reflection of the radiation by precipitation approaching or contacting the window to provide a signal to cause the window wiper arrangement to be energised.

2. Control apparatus as claimed in claim 1 in which the source of radiation is a light emitting diode.

3. Control apparatus as claimed in Claim 1 or Claim 2 in which the radiation is in the infra-red part of the spectrum.

4. Control apparatus as claimed in any one of Claims 1 to 3 in which the source of radiation is arranged to emit the beam as a series of pulses.

5. Control apparatus as claimed in any one of the preceding claims in which the receiver includes a filter transparent to radiation at the transmitted frequency.

6. Control apparatus as claimed in any one of the preceding claims in which the circuit means includes a comparator arranged to be fed signals from the receiver and responsive to a change in mean input signal level to compare the rate of change with a threshold value to provide a control signal indicative of a change, from an ambient level, having predetermined characteristics.

7. Control apparatus as claimed in Claim 6 in which the comparator has two input terminals each arranged to be fed with signals from the receiver, switching means operable when triggered to shunt one of the input terminals to cause the comparator to give a control signal at the comparator output and high pass filter means arranged to receive signals applied to one of the comparator input terminals and responsive to a change in signal level above a predetermined threshold rate to trigger the switching means.

8. Control apparatus as claimed in Claim 6 or Claim 7 in which the circuit means includes means responsive to detection of the wiper sweeping the window subsequent to energisation by detection of precipitation to inhibit operation due to detection only of the wiper.

9. Control apparatus as claimed in Claim 8 in which the means comprises a bistable circuit responsive to a control signal from the comparator to be set to give an output by way of time delay means and a further comparator responsive to a change in receiver signal above a threshold level greater than that due to radiation received

from precipitation to reset the bistable circuit to remove the output signal before it passes through the time delay.

10. Control apparatus as claimed in any one of the preceding claims including timing means operable to cause operation of the wiper arrangements for a predetermined period of time after energisation of the wiper.

11. Control apparatus as claimed in Claim 10 in which the timing means comprises a bistable circuit responsive to an output of the circuit means to be set to give an output to energise the wiper arrangements and a pair of transistors connected such that a first transistor of the pair is turned on by setting of the bistable circuit to initiate charging of a resistor-capacitor network and the second transistor of the pair is responsive to the network reaching a predetermined charging level to turn on and to reset the bistable circuit to de-energise the wiper arrangement.

12. Control apparatus as claimed in any one of the preceding claims including further timing means responsive to a predetermined interval between wiper energisations to energise window washing means simultaneously with the next wiper energisation.

13. Control apparatus as claimed in any one of the preceding claims including clamping responsive to the reception of extraneous radiation to inhibit operation unless the level of change of intensity is within predetermined limits.

14. Control apparatus as claimed in claim 13 in which the clamping means comprises switching means responsive to signals received from the receiver in excess of a predetermined level to switch in one sense to shunt the output of the circuit means and including charging means responsive to the receiver signal falling below said predetermined level to switch in the opposite sense to remove the shunt after a predetermined charging period.

15. Control apparatus for a vehicle window wiper arrangement substantially as herein described with reference to, and as shown by, the accompanying drawings.

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Applicant.

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1596050 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

Fig 1

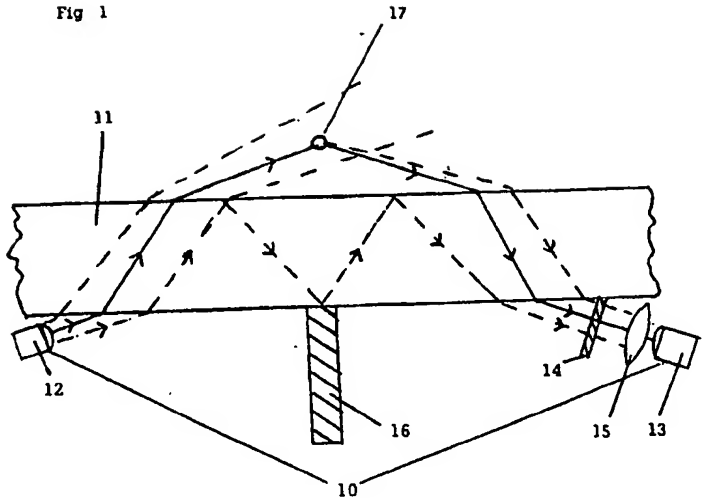

Fig 2

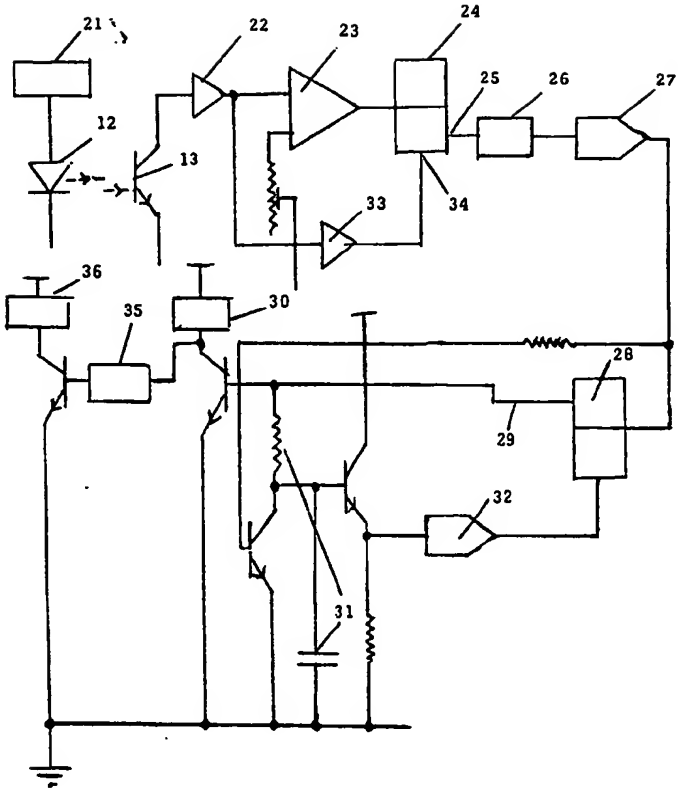

Fig 3(a)

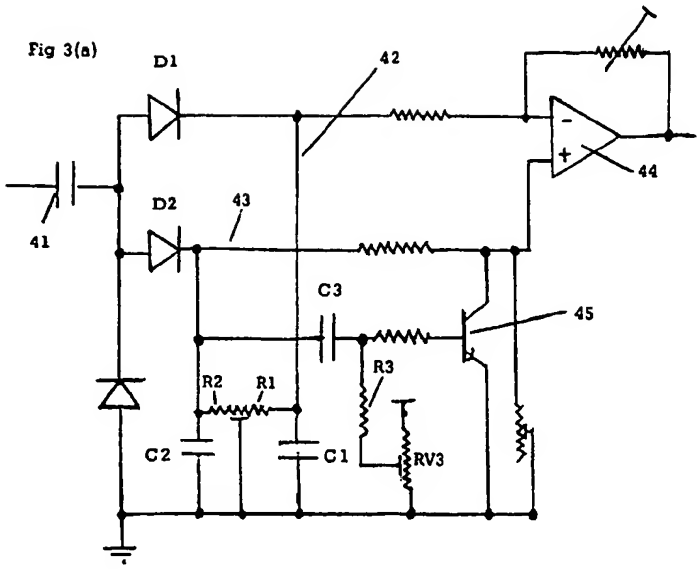

Fig 3(b)